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THE PRINCETON COLLEGE BULLETIN

A QUARTERLY RECORD EDITED BY
THE PRESIDENT AND MEMBERS OF THE FACULTY

CONTENTS

The New Chemical Laboratory,. 45
The Visit of President Stiles, of Yale, to Princeton in 1754, ... 47
The New Regulations for the Doctor's and Master's Degrees, ... 48
Exhibition of Mrs. Garrett's Engravings in the Art Museum, ... 54

ORIGINAL CONTRIBUTIONS:

The Cloister of St. John Lateran in Rome . . 55
Leopold Kronecker, ... 58
Vanadium in Sun Spots, ... 58

SUMMARIES OF PAPERS READ AND PUBLISHED:

A Rapid Method for the Complete Precipitation of Arsenic, etc , ... 59
The Ethics of the Divine Comedy,. 60
Historic Development of Gothic in Italy, . . 62
Note on Sophocles Oed. Tyr. II, 44-45, . . . 64

BOOK REVIEWS:

Ethical Teachings in Old English Literature, by Th. W. Hunt, ... 64
Walter Savage Landor, by E. W. Evans, . 66

NOTES:

Examinations for Doctor's Degrees, ... 66
Honor List of the Class of 1892, ... 67
Changes in the School of Science, ... 68
The Library, ... 68

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MAIN CHEMICAL LABORATORY.—NEW BUILDING.

Princeton College Bulletin.

EDITED BY THE PRESIDENT AND MEMBERS OF THE FACULTY.

Vol. IV. June, 1892. No. 3.

THE NEW CHEMICAL LABORATORY AT PRINCETON.

In a former number of the Bulletin, Feb. 1892, a brief description of this building was given and in the present article it is proposed to give some details relating especially to the various laboratories in it and to the students' desks.

The main laboratory for students is on the top floor and is 71 feet 10 inches long and 50 feet 2 inches wide; the ceiling being 16 feet high. As already stated, it is admirably lighted by windows and a skylight, while efficient ventilation is secured by means of six large flues in the walls, by the windows themselves and by an opening four inches wide, running all around the central skylight and communicating directly with ventilators in the roof. The shortest distance from any window to a working desk is six feet, so that draughts are easily prevented from affecting the burners.

In this laboratory the ordinary routine of qualitative and quantitative chemical analysis is taught to students of all classes, since this mingling of students of all degrees of proficiency has been found to yield good results.

The students' desks are arranged in two sections in rows of six blocks each, the blocks in one section containing eight desks each, and in the other section four desks each. At one end of the laboratory is a continuous row of ten desks. Light from windows on each side of the laboratory, as well as from the skylight, is equally distributed over all of the desks. The general arrangement of the desks is shown in the photograph of the interior of this main laboratory in our plate.

A sink one foot wide is put between each two desks, the sinks being of Trenton white ware, with glass traps. To each student is assigned his private desk, the top of which, excluding the sink, measures 5 feet in length and 2 feet in width, not including the bottle racks. The arrangement of the gas cocks, suction cocks for filtering apparatus and water cocks is shown in the photograph. The desks on the right belong to the blocks containing eight desks; those on the left of the central passage way, to the blocks of four desks. On each side of the large water cocks on these latter desks, and constituting a part of the same cock, is a smaller cock, to which can be attached small rubber hose for connecting condensers, etc. The desks are of ash, and are covered with slate, the top of which is 3 feet 2 inches from the floor. After many tests the slate from the Monson Maine Slate Co., Boston, Mass., was selected as best resisting the action of acids. The reflected light makes it appear light-colored in the photograph, but it is a close-

grained, hard, black slate. The slabs are one inch thick, smooth-finished.

Each desk has two large drawers, and under these is a closet running the whole length of the desk and provided with one double and one single door. Although not very well shown, yet an inspection of the desks at the further end of the laboratory will illustrate the way in which the two drawers and the double doors of each desk are closed by a light brass hasp, which is fastened by a padlock and secures at the same time the drawers and the doors. The single door is fastened by an inside bolt which can be reached from the double doors, thus obviating the necessity of a large number of locks. The reagent bottles of each student are held in racks provided with sliding sashes and the bottles have enameled labels lettered in black.

Lead pipe, extra heavy, carries the waste water from the sinks to heavy cast iron waste pipes which run down the side walls of the building. All of the water, waste and steam pipes are accessible throughout their entire length in the building.

The suction for filtering is furnished by a direct acting steam pump in the adjacent boiler house. This pump was especially fitted for the purpose and has a steam cylinder 7 inches in diameter, air cylinder 6 inches in diameter, with a 6 inch stroke. With a steam pressure of only 10 pounds it has been found adequate to all the needs of the laboratory. The suction is regulated by a receiver of heavy boiler plate, 5 feet high and 2 feet in diameter, provided with a vacuum valve which automatically cuts off the steam when a given vacuum is reached. The pump was made by the A. S. Cameron Steam Pump Co., New York.

The connection between the suction cocks at the desks and the main suction pipe on the same floor is by half-inch lead pipe; the main suction pipe, running to the basement, is of three-quarter inch lead pipe. In the basement are large Wolff's bottles containing solutions of sulphate of copper and of caustic potash, to purify the air, and from these bottles to the receiver (a distance of about 100 feet) the suction pipe is one-inch gas pipe. Although these dimensions seem small, yet under ordinary working conditions there is no perceptible difference between the vacuum at the receiver and at the students' desks. Three of the six hoods in this laboratory are shown in the photograph in sufficient detail to require but little further description. The ash frames have fixed glass sashes on the sides and the sloping top, while the front can be closed by the movable sash, with lead weights. The shelf of each hood is slate, and the cocks of the gas and water pipes are all outside of the hood and underneath the front part of the shelf, while the pipes pass up into the hood through holes in the back part of the slate. Water baths with constant level, sand baths, etc., are provided in these hoods.

The middle passage way shown in the photograph of this laboratory is five feet wide, and between the desks and each side wall is a passage way six feet wide. The distance between the adjacent blocks of desks is 5 feet and 6 inches, so that ample floor and air space is afforded for the number of students in the laboratory.

A drawer under each sink receives waste filter papers and similar solid trash. It should be mentioned that the ten desks in the row at the farther end of the laboratory are six inches shorter than the other desks.

The arrangement of the desks in the smaller laboratory for students on this floor is similar to that already described, but the desks are only 4 feet, 6 inches long, and are in blocks of six, with a semicircular sink at the end of each block. These

smaller desks, while amply large for work in qualitative analysis are hardly large enough for quantitative analysis.

Both of these laboratories are connected with the sulphuretted hydrogen room, which is about 11 feet square and is well ventilated by means of a large window, a shaft from the ceiling through the roof and a large flue in one wall. The sulphuretted hydrogen gas is generated in an adaptation of the apparatus made by Gerhardt for the Bonn laboratory. It consists of a glass cylinder 2 feet high and 5 inches in diameter, to contain the dilute sulphuric acid, with an inner cylinder about three inches shorter. The lower end of this cylinder is pinched together enough to keep the lumps of sulphide of iron with which it is charged from falling out, and the top of it is closed with a rubber stopper through which passes a glass tube, connecting by rubber hose with the wash bottle from which the gas is conveyed to the distributing cocks. The inner cylinder at Bonn is of glass, but at Princeton it is of lead tubing, about 2 inches in diameter. One such simple piece of apparatus furnishes all the gas needed for thirty students at as high a pressure as is ever required. The main service pipe is ordinary half-inch gas pipe, to which are attached nipples connected by short, stout rubber tubing with glass stop-cock tubes, and to these latter, by means of rubber tubing, the students connect the glass tubes which carry the gas into the solutions to be treated. The vessels containing these solutions are all placed within small hoods, closed by sliding glass doors and connected with one large flue.

The private laboratories for Professors and Assistants and the smaller laboratory for advanced students are provided with tables and hoods for the most part similar to those already described.

The assay laboratory in the basement has, for the use of students, several portable Battersea muffle furnaces and a stack of four crucible furnaces, so that each student may be able to have full control of the furnace in which he is making assays.

THE VISIT OF PRESIDENT EZRA STILES, OF YALE, TO PRINCETON IN 1754.

An interesting document has recently come to light, which has some items pertaining to the early history of the college. The Reverend Edward G. Porter, of Dorchester, Mass., discovered the diary of a journey, which Ezra Stiles, President of Yale College, made on horse-back from New Haven to Philadelphia and back in the autumn of 1754. A printed copy of it, which Mr. Porter lately laid before the Massachusetts Historical Society, has been sent by him to the College Library, and from it the following extracts are taken :

"[Sept^{r}.] 24. In morning took horses & with Mr. Kettletas, & 3 other Dutch gent, took boat, & sailed 9 miles across to Staten Island, on which we road, till crossing a small ferry, we arrived at Elizabeth Town Point. Dined at Eliza. Town. Arrived at Newark about 3 aft. Waited on President Burr. Went to prayers, after which 2 young gent. of the college acted *Tamerlane* and *Bajazet*, &c. Lodged with Mr. Burr. 25. Commencement; waited on Mr. Prest. Burr & viewed the college library. Went to meeting, where we saw a most splendid assembly of gentlemen and ladies. In the forenoon heard the Exercises, after which S^{r}. Shippen* pronounced an ingenious oration. Afternoon, M^{r}. President began the exercises with a learned oration. Degrees conferred; among

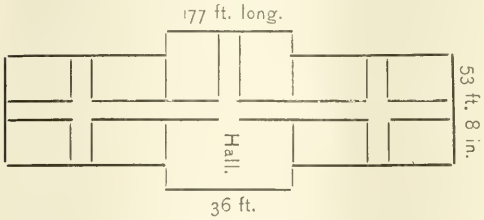
* William Shippen, Jr., M.D., Founder and Professor of the Medical School, College of Philadelphia, then a member of the graduating class, 1754.

others, degree of A. M. on Rev. Mr. Whitefield, who sat with Gov^r. Belcher in pew. Both forenoon & afternoon as the procession entered, & again when they went out of the meeting house, anthems were sung very melodiously by a chorus of men and women in the gallery. About half an hour after academic exercises, M^r. Whitefield mounted on a stage by the Court House, preached a sermon in open air to a large auditory from Luke 1, 15. * * * * * *"

Thence President Stiles continued his journey to Philadelphia, lodging in Princeton. On his return, the following entry is found in the Diary:

"Oct. 1. Breakfasted at Ferry. Viewed foundation and plan of college at Princetown, 177 f. long and 53⅜ f. wide.

Plan N. Jersey college, Princeton:



The atria 10 ft. each.

Mr. Porter states "this plan is drawn three times in the diary, the painstaking writer evidently wishing to have it accurate," and further "that it was the largest stone edifice then in America" and "served as a model for University Hall at Providence, 1790." It will be remembered that the Rev. James Maning, then President of Rhode Island college, was a graduate of Nassau Hall, class of 1762.

We may note several interesting items.

1. It would appear that dramatic performances were early in vogue as it seems "2 young gent. of the college acted Tamerlane and Bajazet immediately after prayers on commencement eve." Query, was this some extract from Marlowe's *Tamburlaine?*

2. Princeton commencements were also early signalized by brilliant audiences. Dr. Stiles was impressed by "a most splendid assembly of gentlemen and ladies."

3. Vocal rather than instrumental music was served on such occasions. Instead of brass bands with their "sonorous metal breathing martial sounds," President Stiles mentions anthems "sung very melodiously by a chorus of men and women in the gallery."

When in 1896, the one hundred and fiftieth anniversary of the college is celebrated, might it not be well to revive this feature at least of one of our earliest commencements? JAMES O. MURRAY.

THE NEW REGULATIONS FOR THE DOCTOR'S AND MASTER'S DEGREES.

Toward the close of President McCosh's administration, the whole subject of University Degrees at Princeton was thoroughly reviewed, and regulations were adopted with the purpose of elevating the character of these degrees to the highest university standards. During the present academic year now closing, these regulations have been subjected to thorough re-examination, in order to incorporate in them such improvements as the experience of the last few years indicates to be desirable. Accordingly, the President and Faculty have devoted prolonged attention to the matter, and the result of their labors is embodied in a pamphlet containing the revised regulations which will be acted upon by the Board of Trustees this commencement.

The general scheme is substantially in accord with the old one, and differs from it only in throwing additional safeguards around the Master's and Doctor's degrees, and in giving greater definiteness and pre-

cision to the regulations generally. The principal changes proposed are as follows:

(1.) Hereafter it is proposed that the Master of Arts degree be conferred only upon the Bachelors of Arts who have done something to earn it, either by one year's exclusive graduate study in Princeton, or by two years' partial graduate study, or by submitting a satisfactory dissertation to the Faculty not earlier than the third year after graduation.

(2.) As the degree of Bachelor of Arts thus naturally leads to the degree of Master of Arts, this in turn is to lead to the final degree of Doctor of Philosophy. Accordingly, those who hold some other bachelor's degree than that in arts, will not be eligible for the degree of Doctor of Philosophy, save in exceptional cases. In the same way the degree of Bachelor of Science is made to lead to that of Master of Science and finally to Doctor of Science, and those who have some other bachelor's degree than that in science are consequently ineligible as candidates for the degree of Doctor of Science, save in exceptional cases. The degree of Doctor of Philosophy, then, is to stand for the sole degree which represents pure liberal culture, and the Doctor of Science to do the same for technical proficiency.

(3.) The experiment of allowing non-resident candidates for the Doctor's degree has been found to involve so much labor in the way of detailed oversight of non-resident candidates as to make it inexpedient to continue it. The safeguards, it is true, have been strictly adhered to, and the candidates have been of a high character, but it is felt that there is no safeguard equal to that of actual University residence.

(4.) The Preliminary Examinations have been somewhat stiffened. Those who apply to become candidates for either doctor's degree will be required, without exception, to read ordinary French and German. Those who come up for the degree of Doctor of Philosophy in the department of Philosophy will need to add a reading knowledge of Latin to the subjects previously required. Those who apply in the department of Language and Literature will have to add a knowledge of general history.

(5.) It will also be noticed that there is greater definiteness in the statement of the Chief Subject which each candidate selects. It has been sought to avoid both the danger of extreme specialization to the injury of breadth of culture, and the opposite danger of superficiality, where the Chief Subject is too comprehensive. Thus, for example, Logic or Ethics, or History or Greek, or Physics or Biology, are specified as Chief Subjects, and by this it is meant that the candidate selecting any one of these will be held responsible for a general knowledge of the whole subject, and will be expected to show in addition a minute and complete acquaintance with some one part of it. This means that a candidate, say in Greek, will need to exhibit at his final examination a general acquaintance with Greek literature as a whole, as well as special proficiency in any period or author he may select. It is hoped by such a provision to promote the production of scholars who will be men of general intelligence, as well as of special excellence in particular subjects, and thus realize within limits the scholarly ideal of "knowing everything about something with something about everything."

(6.) Of the two subsidiary subjects, one must be strictly philosophical in the case of candidates for the degree of Doctor of Philosophy, with the exception noted in the text, and the other must be cognate to the Chief Subject, but not included

under it. In the philosophical subsidiary subject, the history of philosophy would naturally be the principal one chosen. However, Logic, Psychology, or Ethics will be admissible.

(7.) In every case hereafter the thesis, if accepted, must be published by the candidate, and moreover, the final examination must be conducted orally in the presence of the Faculty, and cannot be divided. However, there may be a supplementary written examination in the Chief Subject, at the discretion of the examiner.

(8.) Regulations for the degree of Doctor of Science harmonize in general with those of Doctor of Philosophy, but are specifically adapted to technical rather than liberal scientific scholarship.

The proposed regulations are given in full below:

MASTER OF ARTS (A. M.).

This degree may be conferred only upon a Bachelor of Arts of an approved college who shall have devoted one year exclusively to graduate study in this College under the care of the Faculty, passing examinations upon the studies pursued; or shall have taken at least one University course each term for two years and passed satisfactory examinations upon his work; or shall have submitted to the Faculty a satisfactory dissertation, ordinarily of not less than five thousand words, on some literary, philosophical or scientific subject, not earlier than the first of April in the third year after graduation. The fee for this degree is ten dollars, to be paid to the College Treasurer either before the candidate enters his last examinations, or else when his dissertation is handed in.

MASTER OF SCIENCE (M. S.).

This degree may be conferred upon any Bachelor of Science of an approved institution who shall have devoted one year exclusively to graduate study in this College under the care of the Faculty in such of the following subjects as the Faculty shall prescribe, and who shall have shown satisfactory proficiency therein by dissertations and examinations: biology, mathematics, rational and applied mechanics, practical astronomy, applied chemistry, qualitative analysis, quantitative analysis, physics, mineralogy, graphics, modern languages.

Any Bachelor of Arts, who after examination may be found to be prepared to pursue a University course in science, may become a candidate for the degree of Master of Science on the same conditions as a Bachelor of Science. The fee for this degree is ten dollars, to be paid to the College Treasurer before the candidate enters his last examinations.

THE DEGREE OF DOCTOR OF PHILOSOPHY (PH. D.) IN PRINCETON COLLEGE.

Subject to the regulations hereinafter stated, the degree of Doctor of Philosophy may be conferred upon any Bachelor of Arts of Princeton College, or of any approved College whose Academic course is equivalent to that pursued in Princeton, provided he has spent at least two years in exclusive study for the degree. One of the two years must be spent in Princeton, and the other either at Princeton or some other approved university.

Applications for enrolment as candidates from those who hold some other Bachelor's degree than that in Arts, or for permission to count two or more years spent at another university, as the residence necessary for the degree, will be considered in exceptional cases.

REGULATIONS.

1. *The Preliminary Examination.*

Every applicant before enrollment as a candidate for the Doctor's degree must pass an examination in Princeton on the first Wednesday following the opening of the College in September.

All applicants are examined on their ability to read ordinary French and German with a fluency sufficient to ensure their use as instruments of advanced study.

They are also examined in the group of subjects connected with the general department of their proposed studies, as detailed below:

A. In the Department of Philosophy.
   Ability to read Latin with a fluency sufficient to ensure its use as an instrument of advanced study.
   General Psychology and Logic.
   History of Philosophy, Ancient and Modern.
   Outlines of General History.

B. In the Department of Language and Literature:
   Outlines of General History.
   General knowledge of the English Language and Literature.
   Ability to read Greek and Latin with fluency sufficient to ensure their use as instruments of advanced study.

C. In one of the following six groups in the Department of Mathematics and Science:
   1. In Mathematics.
      Elementary Mathematics, including Trigonometry, Analytical Geometry, the elements of the Theory of Equations and the Differential and Integral Calculus.
   2. In Astronomy.
      Elementary Mathematics, including Trigonometry and Analytical Geometry. General Astronomy. General Physics.
   3. In Physics.
      Elements of Mathematics, including Trigonometry and Analytical Geometry. General Physics.
   4. In Chemistry.
      General Chemistry. General Physics.
   5. In Geology and Physical Geography.
      Elements of Geology, Zoology and Botany. General Chemistry.
   6. In Biology.
      Elements of Zoology and Botany. General Chemistry.

II. *Chief Subject of Study:*

Every candidate, after passing his preliminary examination, and before entering on his studies for the Doctor's degree, shall announce which one of the subjects in the appended lists he selects as his Chief Subject, and shall thereupon present to the Committee on University Degrees and Fellowships for their approval a statement of the said Chief Subject to which he intends devoting himself while a candidate, with such fulness of explanation as the Committee may require.

A. Department of Philosophy:
   Logic.
   Psychology.
   Ethics.
   Metaphysics.
   History of Philosophy.
   Philosophy of Religion.
   History.
   Political Economy.
   Science of Politics.
   Jurisprudence.
   Archæology and Art.

B. Department of Language and Literature:
   Sanskrit.
   Greek.
   Latin.
   French.
   German.
   Italian.
   English (including Anglo-Saxon).

C. Department of Mathematics and Science:
Mathematics.
Astronomy.
Physics.
Chemistry.
Geology and Physical Geography.
Biology.

III. *The Subsidiary Subjects:*

In addition to the Chief Subject, the candidate shall select two suitable Subsidiary Subjects and announce them to his examiners at some time in the first year of his course. One of these must be Logic, Psychology, Ethics, or the History of Philosophy, unless the candidate has chosen for his Chief Subject any one of those just named or else passes a satisfactory special examination on some one of them before entering upon his courses as a candidate. The Subsidiary Subjects should be cognate to the Chief Subject, but not included under it, and with this restriction any study enumerated in the lists of Chief Subjects may be taken, as well as the following which are not thus enumerated: Physiological Psychology, Pedagogics.

IV. *The Thesis:*

The candidate shall present a thesis on some special topic in the department which constitutes his Chief Subject at least four months before the degree can be granted. The thesis is not ordinarily to exceed twenty thousand words in length and shall not be accepted unless it contains evidence of thorough scholarship and ability to pursue original research, and if accepted it must be published by the candidate before the degree can be conferred. If the thesis is not accepted, the candidate will not be admitted to the final examination.

V. *The Final Examination:*

After the thesis has been accepted the candidate may proceed to his final examination at a time appointed by the committee on University Degrees and Fellowships. This examination in the Chief and Subsidiary subjects is to be conducted orally in presence of the Faculty, and cannot be divided. In the Chief Subject, however, there may be a written examination in addition to the oral, if the Examiner so requires. The candidate will be examined on his general knowledge of the Chief Subject, and will be expected to show in addition a minute and complete acquaintance with one principal part of it.

VI. *The Conferring of the Degree:*

Candidates who pass the final examination are ordinarily recommended to the Trustees for the Doctor's degree, and if the Trustees adopt the recommendation, the degree is publicly conferred by the President at the Annual Commencement in June. The degree of Doctor of Philosophy carries with it that of Master of Arts.

VII. *Fees.*

Those who apply for the degree shall pay to the College Treasurer a fee of forty dollars before entering the preliminary examination, twenty-five dollars each year thereafter, and fifty dollars when the thesis is handed in for examination.

THE DEGREE OF DOCTOR OF SCIENCE (D. SC.) IN PRINCETON COLLEGE.

Subject to the regulations hereinafter stated, the Degree of Doctor of Science may be conferred upon any Bachelor of Science of Princeton College, or of any approved college or scientific school whose course is equivalent to that pursued in Princeton, provided he has spent at least two years in exclusive study for the degree. One of the two years must be spent in Princeton, and the other either at Princeton or some other approved university.

Applications for enrollment as candidates from those who hold some other

Bachelor's degree than that in Science, or for permission to count two or more years spent at another university as the residence necessary for the degree, will be considered in exceptional cases.

I. *The Preliminary Examination:*

Every applicant, before enrollment as a candidate for the Doctor's degree, must pass an examination in Princeton on the first Wednesday following the opening of the College in September.

All applicants are examined on their ability to read ordinary French and German with a fluency sufficient to ensure their use as instruments of advanced study and research.

They are also examined in the particular group of subjects connected with the subject of their proposed studies, as detailed below:

1. Mathematics.
   Elementary Mathematics, including Trigonometry, Analytical Geometry, the elements of the Theory of Equations and of the Differential and Integral Calculus.
2. Astronomy.
   Elementary Mathematics, including Trigonometry, Analytical Geometry and the elements of the Differential and Integral Calculus. General Astronomy. General Physics.
3. Physics.
   Elementary Mathematics, including Trigonometry, Analytical Geometry and the elements of the Differential and Integral Calculus. General Physics. General Chemistry.
4. Chemistry.
   General Chemistry. General Physics.
5. Mineralogy.
   Elements (including Crystallography. General Chemistry. General Physics.
6. Geology and Physical Geography.
   Elements of Geology, Zoology and Botany. General Chemistry.
7. Biology.
   Elements of Zoology and Botany. General Chemistry.

II. *Chief Subject of Study:*

After passing the Preliminary Examination every candidate shall announce which of the following departments he selects for his Chief Subject of Study:

1. Mathematics:
   Including Higher Differential and Integral Calculus;
   Differential Equations;
   Geometry (Conics, Higher Plane Curves, Geometry of Three Dimensions);
   Theory of Functions;
   Elliptic Functions;
   Analytical Mechanics.

NOTE.—In the final examination the candidate will also be tested with reference to his ability to make a computation with reasonable skill and accuracy. This will be necessary only where the candidate has had no satisfactory laboratory or observatory experience.

2. Astronomy:
   Including either Practical Astronomy and Theory of Observations,
   Or Computation of Orbits and Ephemerides.
3. Physics:
4. Chemistry:

NOTE.—A portion of the time will be required for the study of Qualitative and Quantitative Chemistry, unless the candidate is already sufficiently proficient in these branches.

5. Mineralogy.

6. Geology and Physical Geography:
   Including either Practical and Engineering Geology, with Field Work,
   Or Application of Palæontology to Determinations of Formations,
   Or Physical Geography.
7. Biology:
   Including the Morphology, Histology and Embryology of some one class of Animals or Plants;
   Physiology;
   Histological Methods and Practice;
   Animal Embryology;
   Modes of Reproduction of Plants.

III. *The Subsidiary Subjects:*

In addition to the Chief Subject the candidate shall select two suitable Subsidiary Subjects and announce them to his Examiners at some time in the first year of his course. The Subsidiary Subjects should be cognate to the Chief Subject, but not included under it, and with this restriction any study enumerated in the lists of Chief Subjects may be taken.

IV. *The Thesis:*

The candidate shall present a Thesis on some special topic in the department which constitutes his Chief Subject at least four months before the degree can be granted. The Thesis is not ordinarily to exceed twenty thousand words in length, and shall not be accepted unless it contains evidence of thorough scholarship and ability to pursue original research, and if accepted it must be published by the candidate before the degree can be conferred. If the Thesis is not accepted the candidate will not be admitted to the final examination.

V. *The Final Examination:*

After the Thesis has been accepted the candidate may proceed to his Final Examination at a time appointed by the Committee on University Degrees and Fellowships. This examination in the Chief and Subsidiary Subjects is to be conducted orally in the presence of the Faculty and cannot be divided. In the Chief Subject, however, there may be a written examination in addition to the oral, if the Examiner so requires. The candidate will be examined on his general knowledge of the Chief Subject, and will be expected to show in addition a minute and complete acquaintance with some one principal part of it.

VI. *The Conferring of the Degree:*

Candidates who pass the final examination are ordinarily recommended to the Trustees for the Doctor's degree, and if the Trustees adopt the recommendation, the degree is publicly conferred by the President at the Annual Commencement in June. The degree of Doctor of Science carries with it that of Master of Science.

VII. *Fees.*

Those who apply for the degree shall pay to the College Treasurer a fee of forty dollars before entering the Preliminary Examination, twenty-five dollars each year thereafter, and fifty dollars when the Thesis is handed in for examination.

EXHIBITION IN THE ART MUSEUM OF MRS. GARRETT'S ENGRAVINGS.

A novel and interesting feature of this Commencement season is the exhibition of a selection of engravings and etchings belonging to Mrs. T. Harrison Garrett. They occupy the entire upper story of the Art Museum, arranged in 418 frames, which are filled with master-pieces of engravings of all schools and periods, selected in such a way as to give a remarkably

complete impression of the varied range of artistic qualities represented in etching, line-engraving and mezzotint, from the fifteenth to the present century. The rooms of the Museum were hastily finished in order to receive the display in time for Commencement. The light, coming through the glass roof, is remarkably good, and the arrangement and grouping have been made with great taste and judgment by Mr. Lee, of Baltimore.

The collection is characterized by the early state of many of the plates and the choiceness of the impressions.

One room is devoted especially to representations of the Holy Family, of which there is a most remarkable series. Among these especially to be noted are four plates of Raphael's Sistine Madonna, the most famous of which is a superb open-letter proof from F. Müller's plate. It is almost invidious to pick out any masters for especial mention. There are fine pieces by Martin Schöngauer, Albrecht Dürer and Luke of Leyden, among the early German masters, and of Marc Antonio among the Italians. Rembrandt's etchings are very fully represented. The French engravings include a large series of the great school of portraiture between the seventeenth and nineteenth centuries, from Nanteuil, Masson, Edelinck and Drevet to Desnoyers. Then there are the charming Belisaire, the Belle Jardiniere and the Vierge au Poisson, by the inimitable Desnoyers. Among the German pieces we notice, for example, the first states of many of Wille's finest plates, and in some cases several states of the same plate; then, artist's proofs of Mandel's and Burger's plates of Raphael's Madonna della Seggiola. Among the works by English artists are some superb mezzotints, several of them by Earlom, and among line engravings, a superb example of Sharp's Doctors of the Church and Wollett's Battle at La Hogue. The Italian engravers of the early part of this century are represented by fine examples, like Raphael Morghen's Last Supper of Leonardo and Raphael's Transfiguration, Longhi's Sposalizio of Raphael, and other works by the founder of the Milanese school, as well as by his great scholar, Pietro Anderlone, and other Milanese artists of his school. Finally, a prominent and most attractive feature is a series by masters of the modern school of etching, there being examples by German, French and English masters.

It is very seldom that opportunity can be had, even in Europe, to see so many fine pieces on exhibition together, and Princeton is deeply indebted to Mrs. Garrett for her kindness and liberality.

ORIGINAL CONTRIBUTIONS.

THE CLOISTER OF ST. JOHN LATERAN IN ROME. PRELIMINARY NOTE.

By A. L. FROTHINGHAM, JR.

Perhaps the two most beautiful cloisters in the world are those of St. John Lateran and S. Paul-outside-the-walls in Rome. Both are known to be works of the first half of the XIII century, but no more precise date has been ascertained. Two elements, however, served to assist in determining more closely the date of the cloister of St. John Lateran, namely, the style of both construction and decoration on the one hand, and the inscriptions giving the names of the artists on the other. The artists were Vassallectus and his father, the former well known as the greatest Roman artist of the XIII century, a sculptor, mosaicist and architect of the first

rank. He worked as late as 1263, and, perhaps, even 1276, and may be said to have been born shortly before or after 1200. At all events, he could scarcely have begun work on the cloister, as a young man, in connection with his father, much before 1220. The same answer is afforded by an examination of other cloisters in Rome and its neighborhood. Those of S. Sisto and S. Sabina, built towards 1220, are far simpler and of an earlier style, and yet the cloister of Sassovivo, near Foligno, dated from 1229, is stated to be in the Roman manner, *opus Romanum*, showing it to be an imitation of some structure in Rome, which can be none other than the cloister of St John Lateran, for the cloister of St. Paul had not yet been built. For these reasons I had already hazarded the opinion (*Journal of Archæology*, 1891) that this cloister could be assigned to the years between 1220 and 1230. This I can now confirm from a contemporary document, dated in 1227. It is the will of Cardinal Guala dei Bicchieri, a well-known diplomat of the XIII century, one of the legates to the Albigenses, and a patron of art, especially of architecture, who died in 1230. In his will, written in Rome in 1227, he leaves ten pounds of Provençal money for the work of constructing the cloister of St. John Lateran, and the wording is such as to show that the building was at that time being carried on. The Cardinal was often in Rome owing to the important share he took in papal politics, and his will is dated from the Church of S. Martino ai Monti. The fact that this clause had not been expunged before his death would show that in 1230 the work was still going on.

LEOPOLD KRONECKER.

By HENRY B. FINE.

Leopold Kronecker, one of the most illustrious of contemporary mathematicians, the senior active professor of mathematics in the University of Berlin and editor-in-chief of the *Journal für reine und angewandte Mathematik* (Crelle), died at Berlin on the 29th of last December in his 68th year.

Kronecker did work of the first importance in no less than three great departments of mathematics: the theory of numbers, algebra, and elliptic functions. As an arithmetician his name is associated with the great names of Gauss, Dirichlet, and Eisenstein; as an algebraist with those of Abel and Galois.

Perhaps his most important contribution to mathematics was his "arithmetical theory" of the algebraic equation, which completes the famous theory of Galois. It carries the general theory of equations back to a theory of indeterminates which, before Galois, it was always assumed to be in the superficial and false sense, that the coefficients and therefore the roots of any equation may be treated as indeterminate.

But the fine quality of Kronecker's work is even more notable than its range or the importance of its results. He set the highest possible standard of mathematical rigor. Early in the *Grundzüge einer arithmetischen Theorie der algebraischen Grössen*, the great memoir in which he gave the first systematic presentation of his arithmetical theory, in defining an irreducible function, he says "Die Definition der Irreductibilität entbehrt so lange einer sicheren Grundlage als nicht eine Methode angegeben ist, mittels deren bei einer bestimmten vorgelegten Function entschieden werden kann, ob dieselbe der aufgestellten Definition gemäss irreductibel ist oder nicht," and proceeds therewith to supply the missing test. And this criterion, according to which no definition may be considered justified, no theorem established, until a method is supplied for determining in

every given concrete case whether the definition or theorem actually applies or not, he everywhere insisted upon, scrupulously meeting its requirements in his own work and sharply criticising all failures to meet them in the works of others. A definition which did not stand this test he denominated the invention of a mere fiction, an artificial abstraction for which there should be no place in mathematics.

This is the rigor of the ancient Greek geometry—in rejecting hypothetical constructions Euclid recognized a similar criterion—and though far enough from being always realized in the modern analysis, must characterize every mathematical theory in its final form. For, until it has been attained, either the ultimate elements of the theory have not been reached or the artificial concepts with which it has aided itself in its growth have not been set aside and the theory deduced directly from these elements.

Closely related to this fine conception of mathematical rigor are the other salient traits of Kronecker's work. It possesses that high artistic merit which consists in the perfect adaptation of means to ends. His methods are always pure, fit, direct, and the simplest which the requirements of absolute rigor will allow. Writing to Dirichlet in 1856 he says of a method which he has discovered for deducing the properties of solvable equations of prime degree, that it meets all the proper requirements of simplicity and rigor, "denn die Methode verlangt keinen irgend höheren Standpunkt mathematischen Fassungsvermögens als das Problem selbst, welches dadurch erledigt wird." And again for his principle of "association" he claims: "Sie gewährt den 'einfachsten' erforderlichen und hinreichenden Apparat, um die arithmetischen Eigenschaften der allgemeinsten algebraischen Grössen 'vollständig' und 'auf die einfachste Weise' darzulegen," adopting the phrases which are quoted from the first proposition of Kirchhoff's Mechanics. This '*Einfachheit*,' to be sure, is of a kind which it oftentimes requires much reflection to appreciate. He was a foe not only of artificial concepts but of all artificial methods and of all artificial or purely formal tendencies in mathematics. He would have rid mathematics of the artificial numbers and of its "symbolic" methods, and the devising of new functions seemed to him a foolish waste of energy. "God created numbers and geometry," I once heard him say, "but man the functions."

It was his boast that he was the most practical of mathematicians. He said whimsically to me one day last summer: "It is a pity that you Americans do not know me better. You would surely appreciate me, I am so practical." And in a somewhat transcendental sense of the word, to be sure, he was profoundly practical. He sought to avoid all mere abstractions and to give his theories concrete form. Thus in the Galois theory he replaced the abstraction, a group of substitutions, by concrete functions which remain unchanged for the substitutions of the group. Neither definition, theorem, nor method had value in his eyes which could not be applied to concrete cases, which could not be made to yield concrete results. On this account he did not set great store by the services of the theory of substitutions to algebra. With all its beauty, he would urge, it is only formal, it does not show how to construct the group of a given equation.

Kronecker influenced the mathematical thinking of Germany as much through his lectures as through his published writings. He was a very stimulating and interesting lecturer. To an unusual degree he took his hearers into his confidence and allowed them the privilege of watching the actual evolution of his thoughts. His lectures

were not overprepared, but the details of even important demonstrations were left to take their chances in the lecture room. Occasionally there would be a disastrous slip in the reckoning or argument, or the outcome would be the discovery that the theorem sought to be established was false. But that only afforded opportunity to see the marvellous quickness with which he would run an error down and recover himself.

His lectures were always fresh. The principal courses were on determinants, theory of numbers, algebra, and definite integrals, and one of these in its turn he delivered each semester. But he never merely repeated himself. If a lecture did not differ from all its predecessors in content, it surely did in point of view or method. It was always the most recent product of his mathematical thinking. In his lecturing, moreover, he avoided the excessive conciseness which is the chief cause of the difficulty of his published writings.

Personally, Kronecker was most charming and amiable, a polished gentleman and man of the world. He was very generous with his time and thoughts, loving to talk to an appreciative listener of some favorite doctrine, or of the famous mathematicians with whom he had been associated.

He was a man of rare genius, a mathematician of the first rank in this century of great mathematicians.

From a paper published in the Bulletin of the New York Mathematical Society, May, 1892.

VANADIUM IN SUN-SPOTS.

By C. A. YOUNG.

In studying the spectrum of sun-spots a curious and interesting result has appeared. It is found that in the orange region of the spectrum the lines of Vanadium, which for the most part are extremely faint in the spectrum of the ordinary solar surface, are almost the most conspicuous of all those which come out as "characteristic" in the spot-spectrum. These lines were noticed long ago as very prominent in sun-spot spectra, but it was not then possible to identify them: the recent photographic observations of Professor Rowland upon the metallic spectra and their correspondence with the solar spectrum, make it now very easy to recognize their true origin. About thirty lines of vanadium exist in the portion of the spectrum which has been examined thus far, and every one of them, without exception, shows more or less widening and intensification, and several of them are even "reversed" through the centre by a fine, bright line. It remains to be seen whether a similar result will be obtained in other parts of the spectrum; and also whether this special conspicuousness of Vanadium is peculiar to a few spots only, or whether it is usual, as is probably the case.

In the course of his observations, Professor Rowland detected the presence of Silicon in the sun's atmosphere, and it is interesting to find that some of the hitherto unrecognized lines in the Chromosphere spectrum are due to this metal.

The existing catalogues of lines peculiar to the spectra of Sun-spots and the Chromosphere were made nearly twenty years ago, and need careful revision. They were made with instruments, which, although the best then available, were far inferior to those now at our disposal, and, of course, the wave-lengths then assigned to the lines are hardly more than approximations, and many of the "identifications" were erroneous, *i. e.*, there are a good many cases where it now appears that a line assigned to iron, for instance, really belongs not to iron, but to some other substance which has a faint line in its

spectrum so near to the iron line that the two appeared as one in the instrument used by the observer in making out his catalogue.

Naturally, therefore, one of the first pieces of work to be taken up here with the new spectroscope is such a revision, and the results hitherto reported are to be considered as merely incidental to its prosecution.

PRINCETON, May 19, 1892.

SUMMARIES OF PAPERS PUBLISHED.

A RAPID METHOD FOR THE COMPLETE PRECIPITATION OF ARSENIC AS THE PENTASULPHIDE, AND FOR ITS SEPARATION FROM BISMUTH, ANTIMONY, LEAD AND SIMILAR METALS.

By FRED NEHER.

Some weeks ago in the course of an application of Dr. L. W. McCay's method for the determination of arsenic as the pentasulphide* to the analysis of a speise it was found necessary to separate small quantities of bismuth from the arsenic solution. The usual methods not proving satisfactory, experiments were made to determine whether arsenic could not be precipitated as pentasulphide in the presence of bismuth, without the simultaneous precipitation of the latter, by simply increasing the quantity of hydrochloric acid present during the action of the hydrogen sulphide. In the course of these experiments it was found that when a stream of hydrogen sulphide is led into a solution of arsenic acid in very strong hydrochloric acid the precipitation of the arsenic begins almost immediately, advances rapidly and approaches completion in a relatively short time.

Over forty carefully conducted tests served to show that by a strict observance of the following conditions the arsenic in an arsenic acid solution can be determined with the greatest facility and accuracy:

1. The solution should contain hydrochloric acid in the proportion of two parts concentrated hydrochloric acid (sp. gr. 1.20) to one part water. A greater excess, however, in nowise impedes precipitation, but seems the rather slightly to facilitate it. As a possible explanation of this action it is suggested that in the presence of such an enormous excess of hydrochloric acid a higher chloride or oxychloride of arsenic is formed, which is more readily acted upon by hydrogen sulphide than the corresponding oxide. The fact that when such a solution is heated arsenic trichloride is formed lends some probability to this view. Experiments show also that the arsenic before precipitating as pentasulphide passes through an intermediate sulpho-compound, possibly $AsCl_3S$, which yields essentially the same reactions as sulphoxyarsenic acid.†

2. A continuous rapid stream of *pure* hydrogen sulphide should be passed into the solution for one hour and a half, though the precipitation is generally complete at the end of an hour. The filtrate should always smell strongly of hydrogen sulphide.

3. The solution must not be heated before or during precipitation; if heated, a part of the arsenic precipitates as trisulphide. Hence care must be taken to mix in the hydrochloric acid slowly, and not to allow the solution meanwhile to undergo any marked rise in temperature.

* Am. Chem. Jour., Vol. IX, No. 3.

† L. W. McCay: Zeit. f. Anal. Chem., Vol. XXVII, pp. 632-634; also, Am. Chem. Jour., Vol. X, No. 6.

Fourteen analyses of various quantities of several carefully standardized potassium arseniate solutions show an average variation of less than 0.0002 grm. in the quantity of pentasulphide obtained from the calculated amount, the greatest variation being 0.0003 grm. The precipitates were weighed in Gooch crucibles after being washed, sometimes with alcohol and carbon bisulphide, generally only with *hot* alcohol, to remove the trace of free sulphur they usually contain, and dried in the air bath at 100° C. I select the following analyses as typical:

	TAKEN.	CALCULATED.	FOUND.
I.	40 C. C. sol. No. 1, 100 C. C. HCl. H_2S 40 minutes.	0.3510 grm. As_2S_5 =0.1698 " As.	0.3509 grm. As_2S_5 =0.1697 " As.
II.	20 C. C. sol. No. 1, 5 C. C. H_2O; 50 C. C. HCl. H_2S 1 hour.	0.1755 grm. As_2S_5 =0.0849 " As.	0.1752 grm. As_2S_5 =0.0847 " As.
III.	15 grms. sol 2, treated as above.	0.1278 grm. As_2S_5 =0 0618 " As.	0.1278 grm. As_2S_5 =0.0618 " As.

The value of this method however lies not so much in its rapidity and accuracy as in the use which may be made of it to separate arsenic from several of the metals which are frequently met with in the course of analyses in solution with it. It has already been found possible to separate arsenic from antimony, bismuth, cadmium and lead by this method, as strong hydrochloric acid solutions of these metals remain clear when treated with hydrogen sulphide. The possibility of successfully applying the method, to the separation of arsenic from several of the other members of the fifth and sixth groups is also being investigated.

Abstract of an article written for Fresenius' Zeitschrift für Anal. Chemie.

THE ETHICS OF THE DIVINE COMEDY.

By E. W. EVANS, JR., Univ. Fellow.

In introducing his subject the writer declared that, in addition to the necessary lights which men of erudition or of critical acumen bring to the illumination of a great poem, the student of philosophy offers his own peculiar contribution. A poem, like any other work of art, is an organism. Besides the flesh and blood of sensuous imagery, which a great poem must abundantly possess, there is implicit in it, as in all developed structures, a complicated skeleton of speculative thought, which it is the privilege of the philosophic critic of literature to explicate. A poem, great enough to be called a world-poem, is one that has penetrated the intellectual and emotional life of many typical individuals, and has portrayed these several sorts of persons in their corporate, moral capacities, as related to family, to society, to the state and to the church. These central questions of theory and morals, which are implicate in the framework of a great poem, the philosophic student of art may render explicit, but in so doing, he does not at all eviscerate the poem as a work of genius; he does not seek to substitute his tentative interpretation of the inner meaning of the poem in place of the "mystic unfathomable song" itself. He merely does for the art-product what the scientist does for physical nature, and the metaphysician does for reality—he sends out the inter-

pretative rays of reason, so that they may rest upon the work of art, and give added light and more profitable pleasure to those who examine the picture or read the poem. The theme and treatment of the Homeric epics were then contrasted with those of the "Divine Comedy;" and the conclusion was reached, that, in Dante's poem, virtue and vice and their fitting consequences were impressively manifested, not as they appear in this world of slow-moving natural law, but as they really are in a world of spirits where facts are seen *sub specie aeternitatis*, under the white light of eternity. Dante's endeavor in the "Divine Comedy" was to represent artistically, and therefore most adequately, the possible attitudes of the human will toward the divine will, and the effects flowing therefrom. The whole structure of the poem, therefore, rests upon the freedom of the will, the question of human freedom being in its turn dependent upon the conception which is entertained of the highest principle of the universe—God. Dante's Christian conception of God was then contrasted with that found in the Oriental religions. The conclusion arrived at was that, as God possessed a completely fashioned will, man, the finite image of his Creator, might serenely intrench himself behind his own limited bulwark of freedom, and act out in time and space that which God knows from all eternity. Personality, with its accompanying responsibility to God, whose perfect nature furnishes the norm of the true and false, the good and evil, is the cornerstone upon which rest the "Inferno," the "Purgatorio" and the "Paradiso." The natural and necessary consequences of sin were then examined in the light of Dante's psychological and figurative treatment of them; and his positive conception of sin was contrasted with a facile ethical optimism current in much of the metaphysical speculation and artistic portrayals of the day. Dante's idea of the relation of the will to the innate endowments of man, his primary appetences and affections, was then discussed. And the emerging problem of love—Dante's word to include the whole range of passion, desire, emotion, affection—as uncontrolled by the will, was developed in its bearing upon the seven cardinal sins. These were then severally graded in a scale of ethical value according as they tend more or less to destroy the social cosmos—which latter is held together by the ethical relationships subsisting between the individual and himself regarded as object, between the individual and God, and between the individual and other persons, or aggregates of persons, as the family, the economic corporation, the church, and the state. It was then explained why these several sins were atoned for in their general and immediate forms in the "Purgatorio," while in the "Inferno" the majority of them were punished in their special effects. This consideration naturally led to the larger question of the fundamental ethical distinction between the sinners in the "Inferno" and those in the "Purgatorio." And it was found that the delinquents whose condition is symbolized under the name of Hell have so smothered their wills in the fumes of inordinate and perverted desire that they have become fatalists; while the souls in Purgatory, not having been dulled by atrophy of the will and by reiterated transgression, comprehend the reaction of sin as the result of freedom, not of fate. The optimistic formula of innocence, sin, developed self-consciousness, is therefore seen to apply only to the latter class of sinners, not at all to the former. It is only as one withdraws into the silent halls of consciousness and there sees written upon his soul by the hand of God and of natural law the

consequences of his own sinful act, that there is the possibility of purification. When our sins are viewed by the clear light of freedom, and not by the obscuration of fate; then, and only then, will we willingly, and like the souls in the "Purgatorio," even eagerly, endure the suffering and shame of sin that thus we may rise purified, and may at last reach that "Paradiso" where will and desire are in glad acquiescence. Then we, as pure spiritual personalities, will love and respect others as pure spiritual personalities, and the vision of God will be assured.

* Abstract of a paper read before the Philosophical Club May 17, 1892.

HISTORIC DEVELOPMENT OF GOTHIC IN ITALY.

By A. L. FROTHINGHAM, Jr.

In passing from the north of Europe to Italy, Gothic architecture took a shape so different in character as to have caused contradictory suppositions as to the source from which it was introduced into Italy, and contradictory judgments as to the artistic character and value of Italian Gothic. After laying down the constructive principles of Gothic as a skeleton of ribs sustaining vaults whose equilibrium is maintained by thrust and counterthrust, the paper of which this is a summary sketched the history of vaulting in France before and during the early Gothic period, and then gave in greater detail the attitude toward vaulting of the various Italian schools of architecture during the two centuries preceding the introduction of Gothic. The Italians were pre-eminently painters and lovers of color; for form they cared less; for the discovery and development of constructional principles they cared almost nothing, except in the north, where the Germanic tribes had brought in an infusion of Northern blood. The wooden roofs were, therefore, preserved throughout Italy, the exceptions being in the case of Byzantine influence as at Venice, in Calabria and other parts of the South; Mohammedan influence as in Sicily, French-Norman influence as in the South, and French-Burgundian influence in the monastic constructions of the Cistercians. The only case of independent development of vaulting was, as indicated above, in Lombardy. There was, therefore, no architectural movement in Italy to which the Gothic could attach itself: it had to be imported and started there on an independent basis. Many critics have thought that it was imported from Germany. The first point of importance in this paper was a series of proofs that the importation was from France, and was not effected at one moment, but was a continuous operation extending over a period of forty or fifty years, beginning in about 1170 or 1175 and continuing through the first quarter of the thirteenth century. The works erected during this period by the French architects and their pupils were purely French in style, or but slightly tinged with Italian peculiarities, and are consequently more pure than the corresponding constructions in Germany or England. The agency for the importation was the Cistercian order of monks. Each of these large monasteries not only required and gave occupation to a large number of architects on account of the number and size of their structures, but had training schools for architects whom they sent out, either to erect affiliated monasteries when they were members of the order, or to practise the style as lay architects. There were about ninety Cistercian monasteries in Italy. Burgundy was the source of the style, and the model structure there may be said to be Pontigny, on which Fossanova, in Italy, was modeled. The same men who built Fossavora appear to have gone from there to

build Casamari and Arabona, shortly after 1200, and then, in about 1218, to S. Galgano, near Siena. At the same time, about 1207, S. Martino al Cimino, near Viterbo, was being built, showing rather the influence of the Ile de-France than Normandy. In the towns and cities near these and other large Cistercian monasteries, the same early Gothic style was used in the cathedrals, parish churches, monastic structures, city halls, castles, private houses. The church of S. Andrea, at Vercelli (1219–24), cited hitherto as the earliest example of Gothic in Italy, is proved to be built on a Cistercian model, and in particular to be copied from such a structure as the Cistercian church of Vaux-de-Cernay.

A second group of buildings, best exemplified by some monuments at Viterbo, show the transition from the Cistercian to the Dominican and Franciscan forms of the Gothic. These two mendicant orders in adopting Gothic at once as their style, showed their usual ability and foresight, and by their action Umbria became the starting-point for a form of Gothic that is specifically Italian.

There are five specifically Italian schools of Gothic which are strongly marked: (1) the Lombard; (2) the Venetian; (3) the Florentine and Tuscan; (4) the Umbrian; and (5) the Angevin, in the South. Most of these borrowed certain traits from the Cistercians, such as, in the ground-plan, the square apse, and in the structure the ribbed cross-vault, though in the use of the latter they retrograded rather than progressed. The principal variations from the Cistercian models were as follows: Owing to the large city congregations gathered in Dominican and Franciscan churches, wider naves and aisles, loftier aisle-vaults and piers more widely spaced, were needed to help eyesight and hearing. Hence the approach in the interiors to the German type of hall-churches, with side-aisles nearly as lofty as the nave, with lofty, heavy piers separating the nave from the aisles. There is no forest of piers, no rhythm of ascending lines, no development of carved mouldings, no great windows filled with painted glass; but in their place a wide expanse of wall covered with frescoes.

Such were the general characteristics: besides these, each school developed special features. The thirteenth century was the period for monastic churches and town halls: the fourteenth century the period of cathedrals. During the first the architects were nearly all monks; during the second they were largely laymen belonging to the art guilds organized in almost every Italian city.

Italian Gothic architects may be said to have achieved the greatest success in their civil and private architecture, whose monuments surpass those of any other country in Europe: the city halls of Florence, Siena, Perugia, Cremona, for example; the palaces of Venice and Verona are examples of their best work.

Finally, a distinction was drawn between *system* and *style*. Some writers have contended that the Italian architecture of this period cannot be called Gothic at all, because it does not carry out logically and fully the principles of Gothic established in France. Granting this, it is only proved that Italy did not adopt the Gothic *system*. But the purely artistic form, the higher art as contrasted to the more material science; what we may call the style of Gothic architecture, is quite another matter. We most emphatically assert that Italy developed in varied form its side of Gothic style, and that it has a perfect right to a place in the European art concert of this period and style.

NOTE ON SOPHOCLES OED. TYR. II. 44–45.

By N. E. CROSBY.

ὡς τοῖσιν ἐμπείροισι καὶ τὰς συμφορὰς
ζώσας ὁρῶ μάλιστα τῶν βουλευμάτων.

This passage is most exhaustively treated by Prof. Jebb in his recent edition of Sophocles' plays. He devotes more than *eleven* pages of his appendix towards elucidating these lines, and successfully refutes, in my opinion, Kennedy's translation of the words ξυμφορὰς τῶν βουλευμάτων by 'comparisons of counsels.' His chief arguments are (1) that the word ξυμφορά nowhere else bears the meaning of 'comparison' in all classical literature; (2) that even if such usage could be admitted, the order of words is decidedly obscure, the genitive τῶν βουλευμάτων being so far removed from the noun ξυμφοράς, the extraordinary meaning of which would scarcely be imagined by the listener, even if the qualifying genitive were close at hand. To my mind, this self-same argument might be used against Prof. Jebb's version of the passage, which follows that of an old scholiast and which translates the phrase by 'the *issues* of their counsels.' I do not deny that the phrase τὰς ξυμφορὰς τῶν βουλευμάτων might mean 'the occurrences that have to do with their counsels' as Prof. Jebb argues, but I contend that ξυμφορά, when found alone without modifying genitive close at hand, is 'a turn of events,' either 'hap' or 'mishap,' usually the latter. Now the listener would most certainly regard the word here as signifying 'mishaps' or 'troubles,' there being no modifier near by and the intensitive καί requiring some stronger idea than simple 'hap' or 'occurrence' would convey. A careful reading of the lines will I think impress this fact on the reader's mind. How then do we explain the genitive των βουλευμάτων? It is the *casual* genitive, the same construction precisely as in line 48, τῆν πάρος προθυμίας (cf. ll. 697 and 1478). We may translate then: 'Since I see generally that in the hands of wise and experienced men *even* troubles (calamities) turn out prosperously, by reason of their counsels.' There can be no question as to the suitability of this rendering to the foregoing lines, or as to the evident force of καί in it, whereas I must confess that to me Jebb's reading, though so stoutly defended by him on the ground of its harmony with the preceding lines, seems decidedly lacking in such accord, and falls rather flat, requiring a somewhat far-fetched explanation both in regard to its proper position in the argument, and the force of the καί.

REVIEWS OF BOOKS.

ETHICAL TEACHINGS IN OLD ENGLISH LITERATURE, by Theodore W. Hunt, Ph.D., Litt.D., Professor of English in the College of New Jersey. 12mo. pp. 384. New York: Funk & Wagnalls Co. 1892.

This book is in a line with those previously published by Professor Hunt, and well known to students of English literature. Its special object, as stated in the preface, "is an ethical one rather than linguistic or critical. Technical and minute discussion is purposely made subordinate to as brief and popular a presentation of the theme as the subject-matter will allow."

There is first an introductory essay on "The Ethical Element in our Earlier Literature," whose aim is to show the presence of the moral element in this literature, and to deduce from this fact some

lessons as to the ethical character of later literature. The author begins with the Celtic age as one of moral preparation, then passes to the age of development, from Caedmon on to the end of the Saxon period. The outstanding characters of this period are Caedmon, Bede and Alcuin. Later came the modification of life and literature by the Danish invasion and the Norman conquest. With the exception of the age of Charles II there is found in all pre-Elizabethan literature a predominating ethical element. The moral indebtedness of all later English literature to this element is emphasized, and the question is raised, whether this prevailing ethical tone characterizes the English literature of the present or not. Professor Hunt finds, in answer to this question, a moral declension, and a need of a profound moral awakening.

The body of his book is divided into two parts: I. The writers from Caedmon to Chaucer, not including the latter; II. The writers from Chaucer to Ascham.

Part first consists of twelve chapters, as follows: Chapter I. Caedmon's Scriptural Paraphrase. "The object of this chapter is to show that, from the seventh century of English song down to the present, the spirit of Caedmon and of Milton has been abroad to keep in abeyance all lower tendencies, and hold the rapidly unfolding volume of English verse loyally true to its earliest ethical standard." Chapter II. The Bible and the Homily in Old English. Special attention is called to the Homilies as a marked feature of English literature down to the time of Wiclif and Tyndale. Then follow brief treatise on "The Ethical Teaching of Beowulf;" "Venerable Bede, the Old English Church Historian;" "King Alfred's Version of Boethius;" "Cynewulf's Trilogy of Christian Song," which is characterized as genuinely poetic and genuinely Christian; "The Church and the School in Old England," in which it is shown that religion was the father of education, the school the child of the church; "Layamon," who stands on the dividing line, at 1200 A. D., between the old and the new in English History, and whose work was strictly transitional;" "Orm, an Old English Poet Homilist;" "Richard de Bury, an Old English Book-Lover;" "Richard Rolle, the Hampole Hermit," and "Old English Saws and Proverbs."

Part second is also composed of twelve chapters treating of "The Ethical Spirit of Chaucer's Writings;" "The Course of the World, a Bible Homily;" "The Church and the Stage in Old England;" "Sir John Mandeville, the Palestinian Traveller;" "John Wiclif, an Old English Reformer and Translator;" "An Old English Religious Satirist," William Langlande, whose Piers Plowman is called a kind of Protestant evangel nearly two centuries before the Protestant Reformation; "John Gower," whose "Vox Clamantis" is the deep and solemn protest of an 'old patriot and religious reformer against the open excesses of his time;' "Old Religious Satire," from 1400 to 1550; "William Caxton;" "Hugh Latimer, the Homilist," whose only literary work was his sermons; "William Tyndale and his Biblical Work," and "Roger Ascham, or English, Old and New," the unique embodiment of old and modern England.

A concluding chapter is added on "The English Bible and the English Language." This gives a historical sketch of the various versions of the Bible, partial and complete, from Aldhelm in the eighth century to the recent revision of King James's version. There is an appendix, containing an Old English version of the Lord's Prayer and the Apostles' Creed, and a reference list of books and authors. The book is dedicated to Professor Francis A. March, of Lafayette College.

J. H. Dulles.

WALTER SAVAGE LANDOR. A Critical Study, by Edward Waterman Evans, Jr., University Fellow, Princeton. New York: G. P. Putnam's Sons, 1892.

This little book aims to present Landor to the reader, not from the standpoint of biography, as does the elaborate work of John Forster, nor yet in the manner of Mr. Sidney Colvin, in his account of the English Men of Letters Series, but "has been written in the effort," as Mr. Evans says in his preface, "to determine Landor's place and function in literature." It is accordingly an essay in literary criticism.

Mr. Evans considers Landor under four aspects: first, as a man of letters; second, as a poet; next, as a master of prose; lastly and briefly, in his relation to literary ideals and methods, with the view of determining his place and quality. At the end Mr. Evans adds, in form of an appendix, a poem of some two hundred verses, entitled "The Shadow in Stone," idyllic in its cast and prompted by Landor's spirit of dealing with æsthetic ideas from the antique. "Landor was an idealist, whose intellectual life lay in the past," is our author's saying in one place (p. 21), and the judgment is a sound one. Not that he confined his searchings and studies to Greek literary products, but that he was truly on the æsthetic side—a late-born Greek, and not wholly in place in the generations of modern men. Hence he had so much tranquillity of spirit within, so much genuine delight in the company of his ideals, and so much noisy unrest and outward annoyance because of what he found about him. His sense of idolation went so far that toward the end of his life he distrusted the thought of his writings having any future fame. "I claim no place in the world of letters," he wrote to Lord Brougham, "I am and will be alone as long as I live, and after." Posterity has judged him better. Though not a writer for the crowd, and of necessity restricted by the subtle and really noble quality of his style, to the few; though deficient "in tact and sympathy for the reader," and almost destitute of spiritual insight, his style is, as Mr. Evans observes, truly "flawless," and he has moreover enriched literature with a choice furnishing of idyllic and dramatic pictures on poetic side, and prose pieces of high critical and æsthetic value, especially in his *Pericles and Aspasia*. That these will always attract spirits kindred to his own, and that his own character has some of the traits that are sure to appear again and again in cultivated men, and above all in men of genius, we sincerely believe.

ANDREW F. WEST.

NOTES.

EXAMINATIONS FOR DOCTOR'S DEGREES.

The following applicants having completed their courses of study and fulfilled all the requirements, were recommended to the Board of Trustees for Doctor's Degrees:

JOHN IRENAEUS MCCAIN, A. B., Professor of Greek and English in Erskine College, South Carolina, for the degree of Ph. D. in Literature.

Subject of Thesis: *Middle English Philology.*

Chief Subject: English. Examined on Period of the Elizabethan Drama, and Textual and Etymological Work in Early English.

Subsidiaries: German Literature of the Eighteenth Century and the Philosophy of Plato.

GEORGE MCLEAN HARPER, A. B., Professor of French in Princeton College, for the degree of Ph. D. in Literature.

Subject of Thesis: *The Legend of the Holy Grail.*

Chief Subject: French. Examined on French Literature of the Seventeenth Century.

Subsidiaries: Italian as Illustrated by Dante, and Thomas Aquinas and his Times.

Charles Graham Dunlap, A. B., Professor of English Language and Literature in Kansas University, for the degree of Litt. D.

Subject of Thesis: *Introduction to a Commentary on The Ploughman's Tale.*

Chief Subject: English. Examined on English Literature.

Subsidiaries: Anglo Saxon and Gothic, and English Constitutional Law.

James Harrington Boyd, A. B., Professor of Mathematics in Macalaster College, Minn., for the degree of Sc. D. in Science.

Subjects of Thesis: "*A Geometrical Study of Certain Cases of the Hyper-Geometric Differential Equation.*"

Chief Subject: Mathematics. Subjects of the Examination: Geometry, Theory of Functions, and Differential Equations.

Subsidiaries: Mathematical Astronomy, and General Physics, with Mechanics and Optics.

The examinations were conducted orally in presence of the Faculty.

HONOR LIST OF THE CLASS OF 1892—ACADEMIC DEPARTMENT.

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Cum laude.

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Robinson Potter Dunn Bennett,
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William Little Bradley,
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John William Easton,
Marcus Stults Farr,
Max Farrand,
Andrew Caldwell Gray,
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History and Political Science,

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John Glover Wilson,
Percy Wilson.

Natural Science,
Marcus Stults Farr.

APPOINTMENTS FOR COMMENCEMENT.
John Glover Wilson, *Latin Salutatory.*
James Peter King, *English Salutatory.*
William Kelly Prentice, *Valedictory.*

HONORARY ORATIONS.
Le Roy Gresham.
Bowdre Phinizy,
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CHANGES IN THE SCHOOL OF SCIENCE.

Since the Department of Chemistry has been removed from the School of Science building to its new quarters in the Chemical Laboratory, there has been a reassignment of rooms to the other departments which occupy the building. The Engineering Department has abandoned the rooms which it occupied as laboratories and recitation rooms, on the south side of the building, and has removed to the rooms left vacant by the Chemical Department. The partitions between Prof. Cornwall's private laboratories and the old drawing room have been removed, and the capacity of the drawing room thus doubled. The Professors in the Engineering Department occupy the rooms which were formerly Professor McCay's laboratory and the store room, and the Engineering laboratory is now in the old Quantitative laboratory. The Mineralogical room has been made into two recitation rooms, and the old Chemical lecture room is now used for Engineering. The Mathematical Department has taken possession of the old Engineering lecture room and of the small recitation room adjoining it. Professor Rockwood's private room is now on the second floor in connection with these new recitation rooms. The lecture room has been fitted with blackboards. The old Engineering laboratory, on the south side, has been turned over to the Physical Department. It has been connected with the Physical laboratory above it by a spiral staircase, and the two rooms are now used as the working laboratories for the class in practical physics. The former apparatus room of the Engineering Department is now the room of the Assistant in Physics. The new Physical laboratory is fitted with tables attached to the walls, and free from the floor, so as to avoid, as far as possible, all disturbances from vibration.

This year the additions to the various classes have been as follows: To the Senior Academic Class, 7; Junior Academic, 8; Sophomore Academic, 18. The Freshman Academic Class numbers 168. To the Junior Scientific Class, 1; Sophomore Scientific 7; the Freshman Scientific Class numbers 91. The First Year Class of the School of Electrical Engineering numbers 11. The total number of entering students enrolled for 1891–'92 is accordingly 311 The total enrollment of the College has increased 96.4 per cent. in the last six years.

THE LIBRARY.

The regular issue of books from the library during the past year reached the twenty thousand point on Monday, June 6. This is an increase of something more than twenty per cent. over the same period last year. The total issue for the year, including one-day books, will be not far from 26,000. The total increase in the issue of regular books for the past year will be about 22 per cent. over last year, and 80 per cent. over the previous year. The use of the alcoves shows that about fifteen thousand visits to the shelves have been made.

"The Development of the Brachiopoda" by Charles Emerson Beecher, Ph.D., appears in *Neues Jahrbuch fur Mineralogie, Geologie und Palaeontologie.*

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